Systematic Literature Review on Technology Adoption: Meta-Analysis Approach

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Abstract

Given the constant development of technology and the multiplicity of models and theories explaining technology acceptance, there is a need to systematise the literature to understand the current state of technology acceptance and provide future research avenues. Given the lack of comprehensive reviews on technology acceptance using comparative and longitudinal insights into factors, this study uses the meta-analysis approach and aims to address three main objectives: 1) identify all factors underpinning technology acceptance without being limited to a specific technology acceptance model, 2) adopt a longitudinal approach to investigate the changes in the effect sizes of factors over time, and 3) compare the predictive strength of three models with three dependent variables (attitude, intention to use and use behaviour). The review will potentially provide theoretical and practical contributions by proposing a comprehensive review of the factors underpinning technology acceptance, thus helping practitioners understand how to design and market technologies.

Keywords: Technology adoption, systematic review, meta-analysis

Track: E-Business and E-Government

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1. Introduction, Research Gaps and objectives

Technology acceptance research has been one of the fastest-growing streams in the IS literature. The popularity of this research domain is due to the constantly developing nature of the technology, thus making the topic timely for decades. On the one hand, fast technology development calls for a fresh insight into the users' side of technology use, to capture the changing users' demands, beliefs, preferences and expectations against the contextual differences, such as culture, geographical location and the difference in technologies (Gupta et al., 2008, Im et al., 2011, Venkatesh and Zhang, 2010, Thong et al., 2011). On the other hand, there is a debate that technology acceptance has become an overly-researched topic in information systems and further scholarly effort in examining technology acceptance creates the illusion of progress in the field, rather than actually developing it (Benbasat and Barki, 2007, Lee et al., 2003). The main breakthrough in the field was due to several prominent models and theories, which have been overly-replicated or extended in further research, thus limiting theoretical and practical contributions to the IS field (Benbasat and Barki, 2007, Venkatesh et al., 2007). Given the controversy in the field, there is a need to systematise the current literature to identify the factors that have been examined to date, explore their predictive strength in relation to use behaviour and investigate whether their reported effect has changed over the years of technology acceptance research. The systematic review of the literature will make it possible to lay the path to future studies based on a comprehensive mapping of the factors underpinning the use of technology.

The current literature provides limited insight into the state of the art of technology acceptance research due to three main gaps. The first gap is that there is a lack of a comprehensive approach (e.g. review based on meta-analysis) examining all factors that affect technology acceptance, with technology acceptance being manifested by intention to use, attitude and use behaviour. Prior literature reviews, opinion papers and meta-analytic studies focused on specific models and theories, such as the technology acceptance model (TAM) or the unified theory of acceptance and use of technology (UTAUT) (King and He, 2006, Williams et al., 2011, Dwivedi et al., 2019, Marangunić and Granić, 2015), or they aimed to extend particular models using a meta-analytical approach. For instance, the review of TAM by Benbasat and Barki (2007) made it possible to conclude that there is a need to focus on different aspects of IS, e.g. on technology design. Venkatesh et al. (2007) and Venkatesh et al. (2003) provided comprehensive reviews on technology acceptance models that have been tested in different contexts. However, the focus on specific technology acceptance models limits the scope of the papers included in the analysis, providing a partial insight into the underpinnings of use behaviour (King and He, 2006, Williams et al., 2011, Dwivedi et al., 2019).

The second research gap is that prior studies have not examined and documented the change in the effect size of acceptance factors over the years. However, the change in the effect size of some factors was noted by Venkatesh et al. (2003). The variance in the effect size indicates the level of importance that the factors play for different generations or in different temporary conditions. For example, at the dawn of IS research, perceived ease of use was the key factor in acceptance (Davis, 1989). However, the adaptation of people to innovative technologies may diminish the role that this construct plays in motivating behaviour. Also, subjective norms and external factors, such as geographical location and culture, which were confirmed to be significant in affecting individuals' behaviour (Venkatesh et al., 2003), might not be important today due to the impact of globalisation. In addition, the critical barriers to technology adoption, such as trust and privacy, may become of paramount importance due to the development of connected devices or could be abated due to the higher awareness and experience of users (Venkatesh et al., 2007). Hence, despite the change in the psycho-

demographic profile of technology users and the level of sophistication of the technologies, no studies have ever attempted to measure the changes in the acceptance factors over time.

The third gap is drawn from the literature, which has been constantly debating whether attitude towards technology use or intention to use is the proxy for use behaviour (Warshaw and Davis, 1985, Davis, 1985, Davis, 1989, Venkatesh et al., 2003, Turner et al., 2010, Straub et al., 1995, Tao, 2009, Calisir et al., 2009). There are mixed findings in the literature, with some scholars arguing that intention to use leads to actual behaviour (Turner et al., 2010, Davis, 1985, Heerink et al., 2008), while others disagree (Straub et al., 1995, Calisir et al., 2009). For instance, the longitudinal study by (Keung et al., 2004) found that the strong intention of employees to adopt technology in an organisation did not translate into actual acceptance. In addition, prior systematic reviews or meta-analytic studies have mainly focused on a single outcome (e.g. intention to use) (King and He, 2006). However, by taking any of the variables as a proxy (attitude vs intention to use), research can be jeopardised by overstressing the importance of one set of factors over the others.

Given the gaps in the literature the objectives of this study are threefold. The first objective is to produce a comprehensive review of all the factors underpinning technology acceptance without being limited to specific technology acceptance models, by adopting the meta-analysis approach. The use of meta-analysis is more rigorous than narrative and qualitative approaches (Rosethal and DiMatteo, 2001), because it is less subjective and judgmental (King and He, 2006). Given that the majority of the research in IS management uses a quantitative methodology, meta-analysis makes it possible to combine the results of prior research in the domain, by considering both the effect sizes and relative samples. Therefore, the results are more credible and statistically explained (King and He, 2006). The second objective is to compare the effect sizes of the factors in technology acceptance on three dependent variables: intention to use, attitude and use behaviour. These three factors are used interchangeably in the IS Management literature to explain and predict the adoption and acceptance of technology (e.g. (Venkatesh and Davis, 2000, Venkatesh et al., 2003, Venkatesh and Bala, 2008)). The third objective is to adopt a meta-longitudinal approach to investigate the changes in the effect sizes of factors over time. In contrast to other review approaches, the meta-longitudinal method will make it possible to statistically measure and understand whether any factors have weakened or become more prominent in predicting technology acceptance.

2. Theoretical and Practical Contributions

This study has the potential to make both theoretical and practical contributions. The first theoretical contribution will be to the technology acceptance literature. First, it will path a future research agenda by proposing a comprehensive technology acceptance model, which will include all the factors that could have a significant effect on acceptance and discard the factors that are no longer important. Such an approach will help address the concerns raised in prior studies (Venkatesh et al., 2007, Benbasat and Barki, 2007) about the repeated replication of established technology acceptance models. Second, the findings of the study will help resolve the debate as to whether intention or attitude can be a proxy for use behaviour. The findings will guide future studies regarding the selection of the dependent variable which would best explain and predict use behaviour. In addition, this study will put forward the methodological contribution in terms of the use of a longitudinal approach in examining acceptance factors. That approach will make it possible to evaluate the change in the strength of certain factors over a long period of time.

3. Methodology

The meta-analytic review is based on a systematic approach to synthesizing the technology acceptance literature, which ensures comprehensive coverage of prior studies in the domain. A three-stage approach, proposed by Tranfield et al. (2003), guided the study to achieve reliability and validity for the findings. These stages include planning the review, conducting the review and reporting the findings. We embarked on the planning stage by starting the preliminary scoping of the technology acceptance literature, proposing objectives and developing a research protocol. Three reviewers were involved in the procedures of the planning stage. The expertise of the reviewers in the field and methodologies increased the potential to adopt a robust approach in examining the topic and to identify novel themes and insights (Hasson et al., 2000). The preliminary scoping of the literature enabled us to identify gaps in the existing literature and find a different perspective for addressing those gaps. Based on the review protocol, all the documents related to technology acceptance were identified and scanned to filter out those which are not suitable for meta-analysis (e.g. qualitative studies).

The conducting stage of the review embraced procedures such as the selection of electronic databases, selection of keywords, finalising the exclusion and inclusion criteria, the extraction of data for analysis and an actual analysis of the data. The Scopus electronic database was used as a source from which articles were searched and extracted, as it provides wide coverage of academic literature. The keywords used for this study are “technology acceptance” or “user acceptance”. The search resulted in 12639 documents. During the filtration process, the advanced search options were enabled, which made it possible to limit the search results based on “publication period”, “document type”, “document source”, and “language”. While there were no restrictions regarding the publication period, the documents were limited to only articles published in English. Due to the focus on the users’ perspective, we were interested in the application and utilisation of technology by people rather than the technical side of technology. Therefore, we excluded research related to computer science and engineering by limiting the disciplines to “social science”, “business management and accounting” “multidisciplinary”, “art and humanities”, "decision sciences” and “psychology”. This filtration process resulted in 1542 ready for download. Following the guidelines by Croom (2009) and Thomé et al. (2016), we conducted an additional backward and forward citation search, which resulted in an additional 127 articles. The utilization of the backward and forward citation search technique made it possible to ensure that relevant articles are not missed. The total scope of the articles reached 1669. All articles were downloaded, to have them manually checked for their suitability for meta-analysis. 69 articles were excluded due to partial information or due to them being revoked. Following the guidelines by Lipsey and Wilson (2001) and Cooper et al. (2019), this review only included studies that have a quantitative research design, and studies that reported the sample size and the type of analysis conducted (e.g. correlation, regression). In addition, we only included studies that examined at least one of the outcome variables, such as intention to use, attitude and use behaviour. After applying those filtering criteria, 723 articles were excluded. Currently, the preliminary sample for the meta-analysis consists of 875 articles.

After downloading the final sample of documents, we embarked on the generation of data and the meta-analysis. Given that meta-analysis is a method by which the cumulative effects of relationships are assimilated from individual studies (Field, 2001), we had to collect data about the relationships between the factors of acceptance and dependent variables. Following the approach adopted by prior meta-analysis studies (King and He, 2006, Agarwal et al., 2018, Dwivedi et al., 2019), the data collection started with the extraction of indices of the reliability of the constructs (Chronbach’s α), sample size, the coefficients of correlation or regression weights and p-values. The final phase will be to run the analysis based on the weights of the relationships. Average effect sizes of the relationships between independent and dependent

variables are calculated based on the cumulated effect sizes of all significant relationships and the number of those relationships. For that purpose, we will download the trial version of the Comprehensive MetaAnalysis Software. The software will make it possible to estimate the cumulative correlation coefficient and generate the effect-size (p-value) and Z-value.

Reference list

AGARWAL, S., STEINMAUS, C. & HARRIS-ADAMSON, C. 2018. Sit-stand workstations and impact on low back discomfort: a systematic review and meta-analysis. *Ergonomics,* 61**,** 538-552.

BENBASAT, I. & BARKI, H. 2007. Quo vadis TAM? *Journal of the association for information systems,* 8**,** 7.

CALISIR, F., GUMUSSOY, C. A. & BAYRAM, A. 2009. Predicting the behavioural intention to use enterprise resource planning systems. *Management research news*.

COOPER, H., HEDGES, L. V. & VALENTINE, J. C. 2019. *The handbook of research synthesis and meta-analysis*, Russell Sage Foundation.

CROOM, S. 2009. Introduction to research methodology in operations management. *Researching operations management***,** 43-83.

DAVIS, F. D. 1985. *A technology acceptance model for empirically testing new end-user information systems: Theory and results.* Massachusetts Institute of Technology.

DAVIS, F. D. 1989. Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly: Management Information Systems,* 13**,** 319-339.

DWIVEDI, Y. K., RANA, N. P., JEYARAJ, A., CLEMENT, M. & WILLIAMS, M. D. 2019. Re-examining the unified theory of acceptance and use of technology (UTAUT): Towards a revised theoretical model. *Information Systems Frontiers,* 21**,** 719-734.

FIELD, A. P. 2001. Meta-analysis of correlation coefficients: a Monte Carlo comparison of fixed-and random-effects methods. *Psychological methods,* 6**,** 161.

GUPTA, B., DASGUPTA, S. & GUPTA, A. 2008. Adoption of ICT in a government organization in a developing country: An empirical study. *The Journal of Strategic Information Systems,* 17**,** 140-154.

HASSON, F., KEENEY, S. & MCKENNA, H. 2000. Research guidelines for the Delphi survey technique. *Journal of Advanced Nursing,* 32**,** 1008-1015.

HEERINK, M., KRÖSE, B., WIELINGA, B. & EVERS, V. Enjoyment intention to use and actual use of a conversational robot by elderly people. Proceedings of the 3rd ACM/IEEE international conference on Human robot interaction, 2008. 113-120.

IM, I., HONG, S. & KANG, M. S. 2011. An international comparison of technology adoption: Testing the UTAUT model. *Information & management,* 48**,** 1-8.

KEUNG, J., JEFFERY, R. & KITCHENHAM, B. The challenge of introducing a new software cost estimation technology into a small software organisation. 2004 Australian Software Engineering Conference. Proceedings., 2004. IEEE, 52-59.

KING, W. R. & HE, J. 2006. A meta-analysis of the technology acceptance model. *Information & management,* 43**,** 740-755.

LEE, Y., KOZAR, K. A. & LARSEN, K. R. 2003. The technology acceptance model: Past, present, and future. *Communications of the Association for information systems,* 12**,** 50.

LIPSEY, M. W. & WILSON, D. B. 2001. *Practical meta-analysis,* SAGE publications, Inc.

MARANGUNIĆ, N. & GRANIĆ, A. 2015. Technology acceptance model: a literature review from 1986 to 2013. *Universal Access in the Information Society,* 14**,** 81-95.

STRAUB, D., LIMAYEM, M. & KARAHANNA-EVARISTO, E. 1995. Measuring system usage: Implications for IS theory testing. *Management science,* 41**,** 1328-1342.

TAO, D. Intention to use and actual use of electronic information resources: further exploring technology acceptance model (TAM). AMIA Annual Symposium Proceedings, 2009. American Medical Informatics Association, 629.

THOMÉ, A. M. T., SCAVARDA, L. F. & SCAVARDA, A. J. 2016. Conducting systematic literature review in operations management. *Production Planning & Control,* 27**,** 408-420.

THONG, J. Y., VENKATESH, V., XU, X., HONG, S.-J. & TAM, K. Y. 2011. Consumer acceptance of personal information and communication technology services. *IEEE transactions on engineering management,* 58**,** 613-625.

TRANFIELD, D., DENYER, D. & SMART, P. 2003. Towards a methodology for developing evidence-informed management knowledge by means of systematic review. *British journal of management,* 14**,** 207-222.

TURNER, M., KITCHENHAM, B., BRERETON, P., CHARTERS, S. & BUDGEN, D. 2010. Does the technology acceptance model predict actual use? A systematic literature review. *Information and software technology,* 52**,** 463-479.

VENKATESH, V., DAVIS, F. & MORRIS, M. G. 2007. Dead or alive? The development, trajectory and future of technology adoption research. *Journal of the association for information systems,* 8**,** 1.

VENKATESH, V., MORRIS, M. G., DAVIS, G. B. & DAVIS, F. D. 2003. User acceptance of information technology: Toward a unified view. *MIS Quarterly: Management Information Systems,* 27**,** 425-478.

VENKATESH, V. & ZHANG, X. 2010. Unified theory of acceptance and use of technology: US vs. China. *Journal of global information technology management,* 13**,** 5-27.

WARSHAW, P. R. & DAVIS, F. D. 1985. Disentangling behavioural intention and behavioural expectation. *Journal of experimental social psychology,* 21**,** 213-228.

WILLIAMS, M., RANA, N., DWIVEDI, Y. & LAL, B. 2011. Is UTAUT really used or just cited for the sake of it? A systematic review of citations of UTAUT's originating article.